No. 822,222. PATENTED MAY 29, 1906.

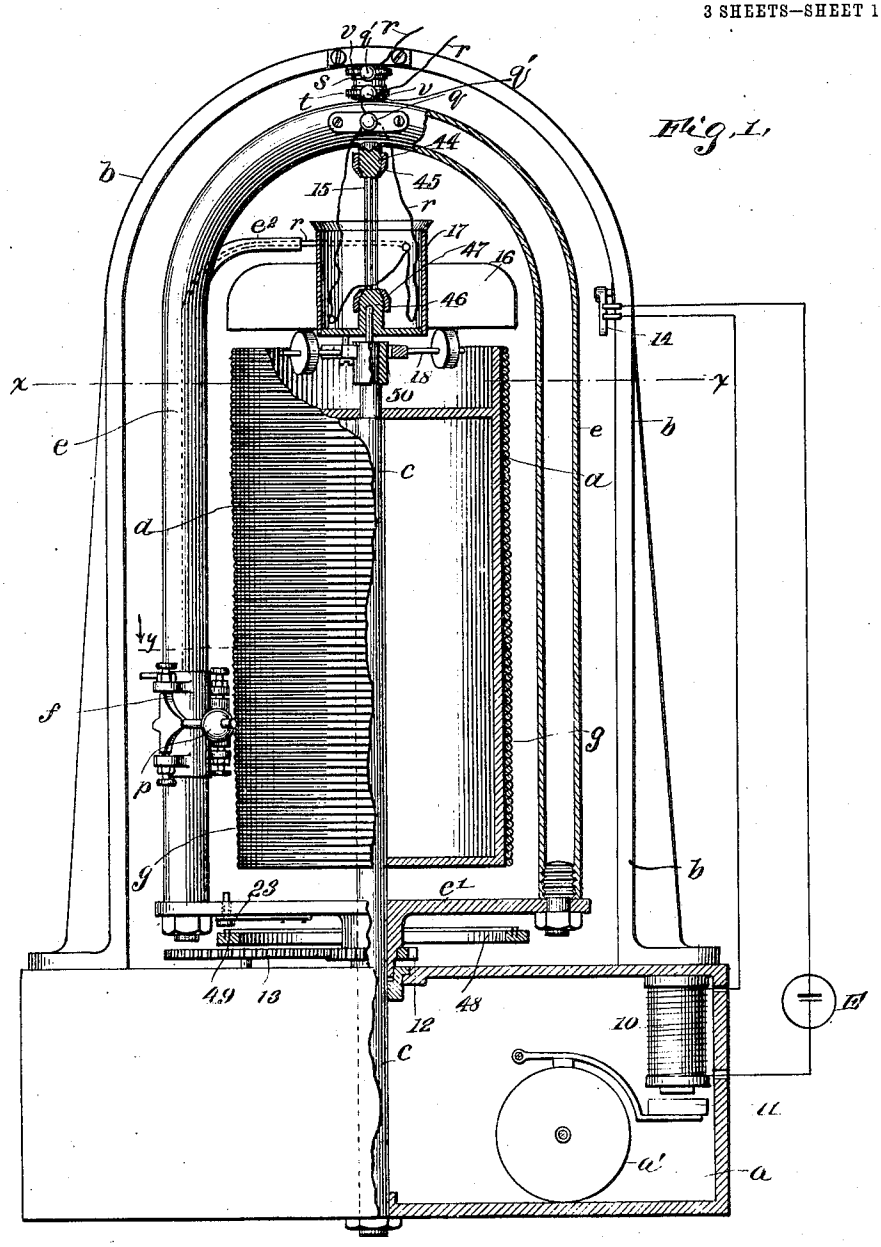
V. POULSEN.

APPARATUS FOR EFFECTING THE STORING UP OF SPEECH OR SIGNALS.

APPLICATION FILED APR. 3, 1900. RENEWED MAR. 20, 1906.

3 SHEETS—SHEET 1.

Fig. 1.



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3 SHEETS—SHEET 2

Fig. 2.

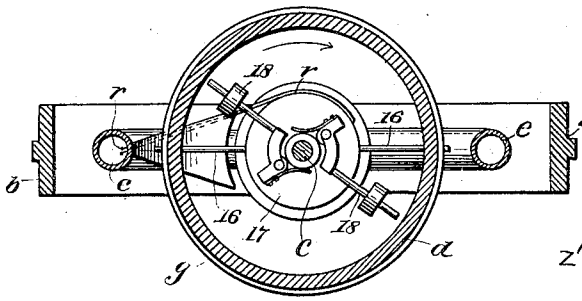


Fig. 4.

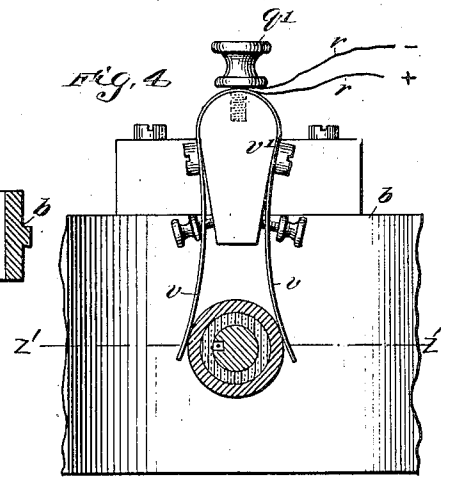


Fig. 3a.

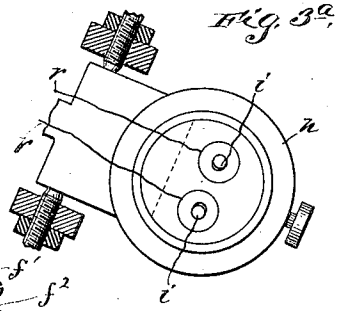
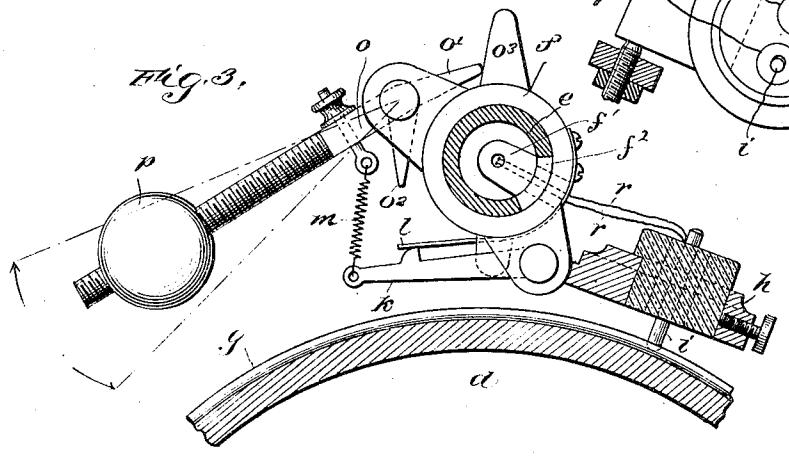


Fig. 3.



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3 SHEETS—SHEET 3.

Fig. 5.

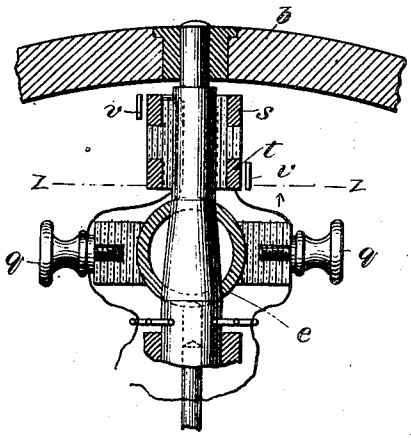
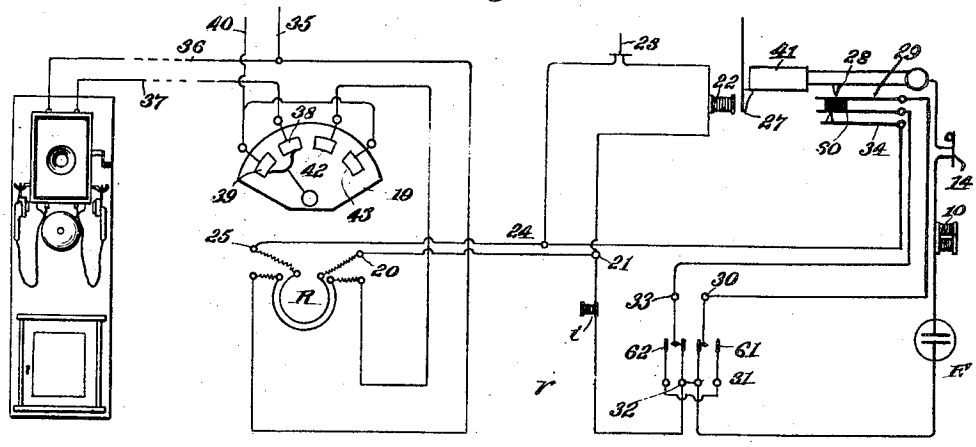


Fig. 6.



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UNITED STATES PATENT OFFICE.

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APPARATUS FOR EFFECTING THE STORING UP OF SPEECH OR SIGNALS.

No. 822,222. Specification of Letters Patent. Patented May 29, 1906.

Original application filed July 8, 1899, Serial No. 723,198. Divided and this application filed April 3, 1900. Renewed March 20, 1906. Serial No. 307,068.

To all whom it may concern:

Be it known that I, VALDEMAR POULSEN, a subject of the King of Denmark, residing at Copenhagen, in the Kingdom of Denmark, have invented certain new and useful Improvements entitled an Apparatus for Effecting the Storing Up of Speech or Signals by Magnetically Influencing Magnetizable Bodies, (for which I have applied for patents in Austria, April 22, 1899; in Hungary, May 1, 1899; in France, April 26, 1899; in Belgium, April 26, 1899; in Italy, May 2, 1899; in Spain, April 26, 1899; in Portugal, May 8, 1899; in Luxemburg, July 26, 1899; in Switzerland, April 25, 1899; in Russia, April 26, 1899; in Finland, May 24, 1899; in Turkey, June 22, 1899; in Norway, April 26, 1899; in Sweden, in Denmark, December 1, 1898; in England, April 28, 1899; in Canada, June 28, 1899; in Brazil, June 20, 1899; in Argentina, July 8, 1899; in Mexico, July 1, 1899; in British India, July 7, 1899; in Japan, August 4, 1899; in Cape Colony, July 5, 1899; in Victoria, December 22, 1899; in New South Wales, December 29, 1899; in South Australia, December 20, 1899; in Queensland, December 27, 1899; in Western Australia, December 19, 1899; in New Zealand, December 21, 1899; in Germany, December 9, 1898, and in Chili, November 18, 1899,) of which the following is a specification, being a divisional part of the application, Serial No. 723,198, filed July 8, 1899.

This application is a division of the application filed July 8, 1899, Serial No. 723,198.

It has long been possible to transmit messages, signals, &c., by electrical means.

The present invention represents a very essential advance in this branch of science, as it provides for receiving and temporarily storing messages and the like by magnetically exciting paramagnetic bodies. The solution of this problem is based on the discovery that a paramagnetic body, such as a steel wire or ribbon, which is moved past an electromagnet connected with an electric or magnetic transmitter, such as a telephone, is magnetically excited along its length in exact correspondence with the signals, messages, or speech delivered to the transmitter and, further, that when the magnetically-excited wire is again moved past the electromagnet it will reproduce the said signals, messages, or speech in a telephone-receiver connected with the said electromagnet.

The invention is of great importance for telephonic purposes, as by providing a suitable apparatus in combination with a telephone communications can be received by the apparatus when the subscriber is absent, whereas upon his return he can cause the communications to be repeated by the apparatus.

Further, the present invention will serve as a phonograph and as such will afford a simple and efficient apparatus.

As is well known, in the usual phonographs the vibrations of air transmitted to a membrane are caused, by means of suitable mechanical parts, to make indentations in a receptive body, which indentations can cause a membrane to repeat the said vibrations by suitable mechanical means.

Mechanical alterations of such bodies, however, give rise to disturbing noises, which apart from the expense of such apparatus is one of the principal reasons why the phonograph has not come more extensively into use.

In the accompanying drawings one form of this invention is illustrated.

Figure 1 is a front elevation and partial section of the phonographic apparatus. Fig. 2 is a section on line $x\,x$ of Fig. 1 looking upward. Fig. 3 is a section on line y of Fig. 1. Fig. 3^a is a side view of the magnet-holder. Fig. 4 is a section on line $z\,z$ of Fig. 5. Fig. 5 is a section on line $z'\,z'$ of Fig. 4. Fig. 6 is a diagrammatic representation of electrical connections designed for the purpose of explaining the mode of operation of the invention.

In the apparatus illustrated the paramagnetic body used consists of a steel wire which is spirally wound on a drum.

The construction of the apparatus is as follows:

a indicates a casing for a clockwork, one of the wheels of which is indicated by *a'*. Upon this casing is supported a stirrup-shaped frame *b*, the two arms of which are arranged on opposite sides of a central spindle *c*. On this spindle is mounted a cylinder *d*, which is held stationary by being fastened to the spin-

dle in any suitable way, and the spindle itself is fixed to the casing.

e is a bow-shaped frame consisting of a piece of tubing bent into shape and having its ends connected by an arm *e'*, mounted to turn on the spindle *c*. The upper end of the bow has a bearing at the middle of the frame *b* by means of a short stud 44, which passes through the bow and enters the frame *b*. The rotary motion is imparted to the bow *e* by means of the clockwork in the casing *a*, which is provided with a wheel 13, engaging with a pinion 12 on the hub of the arm *e'*. A fixed ring 48, carrying two annular electrical contacts 49 on its upper surface, is arranged immediately below the arm *e'*, and said arm is provided with a spring-mounted pin 23, adapted to be forced into connection with both of said electrical contacts for the purpose of electrically connecting them together.

Upon the surface of the cylinder *d* is wound a steel wire *g* in a uniform helix. On one of the arms of the bow *e* is placed a sleeve *f*, adapted to slide freely up and down on the bow, it being held in a fixed relation thereto by means of a tongue *f'* on the sleeve and slot f^2 in the bow or in any other suitable manner. This sleeve has pivoted to it a magnet-holder *h*, the poles of the magnet therein being indicated by *i*. The magnet-holder is provided with a tailpiece *k*, which is normally pressed upon by a spring *l*, tending to force the poles of the magnet out of contact with the wire *g*.

p represents a weight adjustably fixed on an arm *o*, pivoted to the sleeve *f*. The arm *o* is connected with the tail *k* by a spring *m*. Centrifugal force acting upon the weight *p* tends to throw the magnet-holder toward the cylinder *d* and thus bring the poles of the magnet into contact with the wire *g*, in which operation the spring *l* is compressed, so that the centrifugal force ceases. Said spring will act upon the tailpiece *k* to remove the poles of the magnet from the wire *g*. The arm *o* has two extensions *o'* and o^2, which serve as stops to limit the movement of the weight *p* in both directions. The sleeve is also provided with a finger o^3, the purpose of which will be explained hereinafter. With reference to the magnet *i* it may be stated that it may have one or two of its pole-pieces arranged to engage the wire *g*. If a single pole-piece is used, the end thereof will be rounded or made wedge shape to fit between two adjacent convolutions of the wire and in contact with both of them, while if the two pole-pieces are used, as is shown in the drawings, they may make contact with opposite sides of a single convolution of the wire, the poles being pointed for that purpose, or they may slide in the adjacent grooves between the wires and straddling one convolution.

The two wires *r r*, in which the magnet *i* is connected, lead from the magnet through the open slot in the bow *e*, thence upward through said hollow bow to a point near the upper end thereof, where they pass out through a flaring nozzle e^2, and thence around the outside of a drum 17 through a hole in the side thereof, thence upward to a pair of binding-screws *q q*, arranged on the opposite sides of the bow *e* at its middle point, the wires being slack between said binding-screws and the opening in the drum. From said binding-screws the wires lead on, respectively, to two insulated rings *s* and *t* on the short stud 44. Upon each of these rings a contact-spring *v*, attached to a block *v'*, rests, and to these springs the main wires are respectively connected by means of the binding-screws *q'*. The said drum 17 is mounted freely on the upper end of the spindle *c*, and on its under side it has pivoted to it two weighted levers 18, each of which carries a spring forming a brake-shoe resting upon the surface of the fixed spindle *c*. These weighted levers are so arranged that centrifugal force will increase the pressure of the brake-shoes upon the spindle, and so retard the rotary motion of the drum 17. The drum also carries a pair of wings 16, which have a retarding effect upon the rotary motion of the drum. The drum is connected with the bow *e* by a flexible or yielding connection consisting of a number of wires 15, which are clamped to the drum by a conical nut 47, engaging with the hub 46, and with the bow by a similar nut 45, engaging with the end of the stud 44. It will now be seen that when the bow *e* rotates it will carry the drum 17 with it; but owing to the action of the brake 18 and the wings 16 there will be a certain amount of lagging on the part of the drum, which will be permitted by the twisting of the wires 15.

The clockwork is normally prevented from rotating by the weight of the armature 11, which acts upon the brake, as shown in Fig. 1. The brake is released by the electromagnet 10 in a circuit with battery E and a cut-out 14, attached to the frame *b*.

The apparatus so far described is a phonograph, the operation of which may now be referred to.

Let it be assumed that speech or signals are being electrically transmitted over the circuit containing the magnet *i*, that the sleeve *f* is at the lower end of the bow, and that the machine is started by closing the circuit of magnet 10. The bow *e* immediately commences to rotate around the cylinder *d*. When the speed is sufficient, centrifugal force acting upon the weight *p* will cause the core of the magnet *i* to be thrown into contact with the wire *g*, whereupon the sleeve will be caused to slide upward upon the bow, owing to the spiral arrangement of the wire on the cylinder. At the same time the undulations of current in the circuit of magnet *i* will vary the mag-

netism of said magnet, which variations will be successively imparted to the wire *g*. The message may continue until the sleeve *f* reaches the elevation of the cut-out 14, whereupon the finger o^3 on the sleeve strikes said cut-out and swings it to one side, thus opening the circuit of magnet 10. Armature 11 then falls and stops the clockwork, whereupon spring *l* withdraws the poles of the magnet *i* from wire *g*, and the sleeve falls by gravity to its lower position. The brake 18 is adjustable, so that the lagging of the drum 17 behind the bow *e* will be just sufficient to wind the wires *r* upon the drum as the slack in said wires is created by the upward movement of the sleeve *f*. To reproduce the message which has thus been magnetically recorded, it is only necessary to put a receiving-telephone into circuit with magnet *i* instead of the transmitting-telephone and then start the machine again, whereupon the sleeve will travel up on the bow and the poles of the magnet will traverse the wire *g*, the successively-varying magnetic condition of which will react upon the core of the magnet and cause the same undulations of current to be sent over the line to the receiving-telephone as were previously sent over the line to the magnet from the transmitting-telephone.

The connection of the apparatus to a telephone is shown in Fig. 6. A switch 19 is provided, having four terminals 38, 39, 42, and 43. These terminals can be connected with each other in three different ways by means of the switch-lever. In the position shown in the drawings the two terminals 38 and 39 are connected together. This position establishes the circuit for the ordinary use of the telephone. The current passes through the conductor 35, the conductor 36, to the telephone, and through the conductor 37, terminals 38 and 39, back to the conductor 40. The two conductors 35 and 40 constitute the outgoing and return lines.

If the switch-lever is so adjusted as to connect the two terminals 38 and 42, the apparatus can then be used as a phonograph, and the transmitting-telephone belonging to the same station can then be used. To clearly explain this, the course of the current should be followed when the terminals 38 and 42 are connected. When the subscriber turns the crank-handle of his induction apparatus, a current will pass through the outer coil of the induction-coils R. The current issues from the telephone and passes over the conductor 36 to the outer coil of the induction-coils R, then through the terminals 42 to the terminals 38, and over the conductor 37 back to the telephone. A current is then induced in the inner coil of the induction-coils R, which will take the following course: It passes from the terminal 20 of the inner coil of the induction-coils R to the electromagnet 22, through the contact 23, conductor 24, terminal 25, back to the inner coil of the induction-coils R. The electromagnet 22 is thus excited and the armature 27 attracted, whereupon a weighted block 41 is released and falls. By this means contact is made between the contact-piece 28 and spring 29, whereby the local circuit of the battery E is closed. The circuit is as follows: The current passes from the battery E through the electromagnet 10, contact 14, contact-piece 28, spring 29, terminals 30 and 31 and back to battery E. The electromagnet 10, Fig. 1, now attracts the armature 11, so that the clockwork is set in motion and the bow *e* rotated. The sleeve *f*, which has been resting upon the pin 23, begins to rise, and the connection between the contacts 49 is broken. The contact 23 consequently exists only for an instant, so that the circuit of the conductors 20, 21, 22, 23, 24, and 25 is open during the operation of the clockwork and apparatus. Now during the rise of the sleeve *f* and while the electromagnet *i*, Fig. 3, is in contact with the steel wire *g* in the manner described the subscriber can speak into his transmitter, and the spirally-wound steel wire *g* will be correspondingly magnetically excited. The course of the current in this case is as follows: It passes from the telephone apparatus through the conductor 36, the outer coil of the induction-coils R, and the terminals 42 and 38, conductor 37, back to the transmitter. In exact correspondence with the matter spoken into the transmitter currents are induced in the inner induction-coil. Such currents issue from the terminals 20 and 21, pass through the electromagnet *i*, conductor *r*, terminals 32 and 33, contact-springs 60 and 34, terminals 24 25, back to the inner induction-coil. The contact between 60 and 34 is also effected by the falling of block 41. The electromagnet *i* is magnetized in correspondence with the matter spoken and transfers its magnetism to the steel wire *g*. The matter thus fixed can now be transmitted over the line by using the third connection—that is, by connecting the terminals 42 and 43 of the switch 19. If, for example, the message, "The subscriber is not at home at present, but will return at four o'clock, at which time please ring again," is fixed to the steel wire and a subscriber at some other station calls the former, when the contact-pieces 42 43 are connected together the following circuit will be described: The induced current from the transmitting-station will first pass over the conductor 35 to the outer coil of the induction-coils R and then through the terminals 42 43, whereupon it will pass through these to the line 40, because the terminal 43 is connected with the terminal 39. The line-current will accordingly not pass through the telephone of the receiving-station, but, because the contact 23 is then closed, the electromagnet 22 is again excited by the current

generated in the inner coil of the induction-coils R and the drum *d* is rotated. The electromagnet *i* will slide along the fixed wire *g* and gradually rise with the sleeve *f* and will be magnetized in accordance with the speech fixed on the wire. The currents induced thereby pass from the electromagnet *i*, Fig. 6, through the terminals 33, contact-springs 60 and 64, terminals 24 25 to the inner coil of the induction-coils R, and then through the terminals 20 and 21 to the electromagnet *i*. In the inner coil of the induction-coils R a current is induced corresponding to the speech fixed to the steel wire, which current likewise acts in the outer coil of the induction-coils R and passes thence through the terminals 42, 43, and 39 to the line conductor 40 and back over the conductor 35 into the outer coil of the induction-coils R. The subscriber at the transmitting-station now hears through his receiver the message fixed to the steel wire and knows that in order to speak with the subscriber at the receiving-station he must call him up at four o'clock.

In order to obliterate the successive magnetic conditions of the steel wire *g*, Fig. 1, the terminals 30 and 33, Fig. 6, are connected with 61 and 62, whereupon the following connection is made: The current passes from battery E through the terminals 31 and 32 to the electromagnet *i*, through the terminals 21 20, inner coil of the induction-coils R, terminal 25, contact-springs 34 60, contacts 33 62 61 30, contact-spring 29, contacts 28 14, electromagnet 10 back to the battery E. The electromagnet *i* is in this position of the switch uniformly magnetized by the battery E and demagnetizes thereby the steel wire *g* on the bow *e* rotating.

For telegraphic purposes the invention can also be used with advantage. It is in such case only necessary to receive the current impulses transmitted over the line in the electromagnet while it is in contact with the paramagnetic body. The paramagnetic body may be moved past the electromagnetic, or vice versa.

Having described my invention, I claim—

1. An apparatus for storing and reproducing electrical impulses which consists of the combination of an electric circuit including an electromagnet, a paramagnetic surface located within magnetizable range of said electromagnet, means for moving the surface and magnet with respect to each other so that different portions of the surface will be successively presented to the magnet, and means whereby magnetic impressions of said impulses are caused to pass to and from said body through the magnet, substantially as described.

2. An apparatus for storing and reproducing electrical impulses, which consists of an electromagnet, a paramagnetic surface within the magnetic influence of said electromagnet, means for moving the magnet and surface with respect to each other, so that different portions of the surface will be successively presented to the magnet, and means whereby magnetic impressions of said impulses are caused to pass to and from said body through the magnet, substantially as described.

3. An apparatus for storing or recording speech and other sounds, which consists of the combination of an electromagnet, means for altering its magnetic condition according to said speech or sounds, a paramagnetic surface within the influence of said magnet and means for moving the surface and magnet with respect to each other, so as to present different portions of the surface to the magnet successively, substantially as described.

4. An apparatus for storing or recording electrical impulses, which consists of an electromagnet, a circuit over which such impulses flow, in combination with a paramagnetic surface in contact with the pole or poles of said electromagnet, and means for moving said magnet and surface, the one past the other.

5. An apparatus for storing or recording electrical impulses, which consists of an electromagnet in a circuit over which such impulses flow, in combination with a strip of paramagnetic material subjected to the influence of said magnet, and means for successively presenting different parts of the strip to the magnet, substantially as described.

6. An apparatus for storing or recording electrical impulses, consisting of an electromagnet in a circuit over which such impulses flow, in combination with a strip of paramagnetic material in the form of a spiral, and means for successively presenting different parts of the strip to the magnet, substantially as described.

7. An apparatus for storing or recording electrical impulses, consisting of an electromagnet in a circuit over which such impulses flow, in combination with a strip of paramagnetic material in the form of a spiral, and means for holding the pole or poles of the magnet and the strip in contact with each other, while, at the same time, moving them with respect to each other.

8. An apparatus for storing and reproducing electrical impulses, which consists of an electromagnet in a circuit over which such impulses pass, in combination with a cylinder, a paramagnetic strip spirally wound upon such cylinder, said magnet being adjacent to the surface of the cylinder, and means whereby the pole or poles of the magnet will be dragged in contact with the spirally-wound strip from end to end thereof, substantially as described.

9. In an apparatus for storing and reproducing electrical impulses, the combination

of a stationary cylinder, a magnetizable body located upon the surface of said cylinder, a frame arranged to rotate concentrically around said cylinder, and an electromagnet carried by said frame and having its pole or poles presented to said magnetizable body, a circuit over which said impulses pass and which includes said magnet, and means for causing the magnet to traverse in a direction parallel to the axis of the cylinder, while the frame which supports it is rotated around it.

10. In an apparatus for storing and reproducing electrical impulses, the combination of a stationary cylinder, a magnetizable body attached to the surface of such cylinder, a frame arranged parallel to the axis of the cylinder, a motor adapted to rotate the frame around the cylinder, an electromagnet carried by said frame and having its pole or poles in contact with said magnetizable body, means for causing the magnet to traverse along said frame and across the face of the cylinder, while said frame is being rotated, and means for automatically stopping the motor when the magnet has made its full travel.

11. In a telephone system, the combination with a subscriber's circuit and station, of a paramagnetic body, an electromagnet whose pole or poles are presented to the said body, means for moving the body and magnet with respect to each other, so as to present successive portions of the body to the poles of the magnet, and means for throwing the magnet into and out of the subscriber's circuit, substantiallly as described.

12. In an apparatus for storing and reproducing electrical impulses, the combination of a paramagnetic body, an electromagnet in a circuit over which such impulses flow, means for causing said body and said electromagnet to move with respect, and in close proximity, to each other, so that the relative position of the electromagnet will be gradually shifted from one end to the other of said body, and means for withdrawing said magnet from its working position and returning it to its starting position, substantially as described.

13. In an apparatus for storing electrical impulses electromagnetically, the combination of an electromagnet in an electric circuit over which such impulses flow, a body adapted to receive and retain magnetic conditions or impressions from said electromagnet corresponding to said impulses, a constant source of electricity, such as a battery, and another electric circuit including said source and said electromagnet, for the purpose of imparting a constant or neutral condition to the said magnetizable body and eliminating therefrom any magnetic conditions which may be established by said impulses.

14. In an apparatus for storing or recording electrical impulses representing speech, sounds or signals, the combination of a paramagnetic body containing magnetic impressions of said impulses distributed in a line along the same, a source of constant magnetism and means for subjecting said impressions to said source of constant magnetism for the purpose of imparting a uniform magnetic condition to said body.

15. An apparatus for storing or recording electrical impulses, which consists of the combination of an electric circuit over which such impulses flow and which includes an electromagnet, a body or surface capable of retaining magnetic impressions or conditions and means whereby the impulses flowing in said electromagnet will cause corresponding magnetic impressions or conditions to be made at successive points in said body or surface.

16. An apparatus for reproducing electrical impulses which have been previously recorded magnetically at successive points in a magnetizable body, consisting of a circuit containing an electromagnet, in combination with means for subjecting said electromagnet successively to the influence of the magnetism stored at the successive points in said magnetizable body.

17. In an apparatus for storing and reproducing electrical impulses corresponding to speech or signals, the combination of means for making a magnetic record of such impulses in a magnetizable body, an electromagnet and receiving apparatus, a circuit including said electromagnet and receiving apparatus and means for causing said magnetic record to act upon said electromagnet to thereby reproduce the said impulses in the circuit of said electromagnet.

18. In an apparatus for magnetically recording electrical impulses, the combination of an electromagnet in an electric circuit over which such impulses flow, a magnetizable body adapted to receive magnetic impressions from said electromagnet corresponding to said impulses, a magnetic apparatus possessing or capable of possessing a constant degree of magnetism and means for subjecting said magnetizable body to said apparatus to impart a constant or neutral condition to said body.

19. In an apparatus for receiving and recording electrical impulses magnetically, the combination of a paramagnetic body in which the record is made, a magnet having a constant field of force and means whereby that portion of said body containing the record may be passed through or within the field of force of said magnet, to thereby obliterate the record.

20. An apparatus for reproducing electrical impulses which have been previously magnetically recorded at successive points in a

magnetizable body, consisting of an electromagnetic coil, a circuit in which said coil is included and means for moving the coil and magnetizable body with respect to each other so that the coil is successively brought within the influence of the magnetism recorded at the successive points in said magnetizable body, whereby current impulses are successively generated in said coil and its circuit which correspond with the impulses which originally created the record.

21. In an apparatus for storing and reproducing electrical impulses, a paramagnetic body and a magnet, one of these being movable in relation to the other, the poles of said magnet being in magnetizable range of the said body, means for causing electrical impulses in the circuit of said magnet and an electrically-controlled motor adapted to effect the said relative movements of the body and magnet, substantially as described.

22. In an apparatus for storing and reproducing sounds and signals and in combination, a paramagnetic body, an electromagnet having its pole or poles presented to said body, means for supporting and for changing the relations of said body and magnet with respect to each other and transmitting and receiving mechanisms whereby electrical impulses are caused to pass to and from the said body through said magnet, substantially as described.

23. The combination of a body containing magnetic impressions of electrical impulses at succeeding points, an electromagnet adapted to be subjected successively to said impressions and a circuit containing said electromagnet.

24. The combination of a body having a smooth surface permanently charged with magnetism of varying degrees at succeeding points, an electromagnet presented to said surface and means for moving the body and magnet with respect to each other.

25. An apparatus for recording and reproducing electrical impulses, consisting of a body capable of receiving and retaining magnetic impressions, an electromagnet, a circuit including said magnet, a transmitter adapted to send electrical impulses over said circuit to energize said magnet and cause it to communicate its magnetism to said body, and a receiver adapted to be actuated by impulses produced in said circuit by the reaction of the magnetism in said body upon said electromagnet.

26. An apparatus for storing and reproducing electrical impulses which consists of the combination of an electric circuit including an electromagnet, a homogeneous paramagnetic body located within magnetizable range of said electromagnet, means for moving the body and magnet with respect to each other so that different portions of the body will be successively presented to the magnet, and means whereby magnetic impressions of said impulses are caused to pass to and from said body through the magnet, substantially as described.

27. An apparatus for storing and reproducing electrical impulses, which consists of an electromagnet, a homogeneous paramagnetic body within the magnetic influence of said electromagnet, means for moving the magnet and body with respect to each other, so that different portions of the body will be successively presented to the magnet, and means whereby magnetic impressions of said impulses are caused to pass to and from said body through the magnet, substantially as described.

28. An apparatus for storing or recording speech and other sounds, which consists of the combination of an electromagnet, means for altering its magnetic condition according to said speech or sounds, a continuous paramagnetic surface within the influence of said magnet and means for moving the surface and magnet with respect to each other, so as to present different portions of the surface to the magnet successively, substantially as described.

29. An apparatus for storing or recording electrical impulses, which consists of an electromagnet in a circuit over which such impulses flow, in combination with a homogeneous strip of paramagnetic material subjected to the influence of said magnet, and means for successively presenting different parts of the strip to the magnet, substantially as described.

30. An apparatus for storing or recording electrical impulses, which consists of the combination of an electric circuit over which such impulses flow and which includes an electromagnet, a homogeneous body or surface capable of retaining magnetic impressions or conditions and means whereby the impulses flowing in said electromagnet will cause corresponding magnetic impressions or conditions to be made at successive points in said body or surface.

31. In an apparatus for storing and reproducing sounds and signals and in combination, a paramagnetic body, an electromagnet having its pole or poles transversely presented to said body, means for supporting and for changing the relation of said body and magnet with respect to each other and transmitting and receiving mechanisms whereby electrical impulses are caused to pass to and from the said body through said magnet, substantially as described.

32. The combination of a body having a smooth homogeneous surface permanently charged with magnetism of varying degrees at succeeding points, an electromagnet transversely presented to said surface and means for moving the body and magnet with respect to each other.

33. The combination of an electric circuit including a signal-transmitting mechanism and an electromagnet, a body or surface capable of receiving and retaining magnetic impressions or conditions and arranged so that a portion of it is traversed laterally by the lines of force of the magnetic field of said magnet, and means for moving the magnet and body relatively to each other to cause successive portions of the body to cut the lines of force in the magnetic field of the magnet.

34. The combination of an electric circuit including a signal-transmitting mechanism and an electromagnet, a body or surface capable of receiving and retaining magnetic impressions or conditions and arranged transversely to or across the lines of force of the magnetic field of said magnet and means for moving the magnet and body relatively to each other to cause successive portions of the body to cut the lines of force in the magnetic field of the magnet.

35. The combination of a body capable of receiving and retaining magnetic impressions or conditions, an electromagnet arranged so that its field of force is at an angle to the surface of said body and means for moving said body and magnet relatively to each other so that the field of force of the magnet will cut successive portions of said body.

36. The combination of a body containing a trail of magnetic conditions or impressions, an electromagnet whose axis or polar line is presented at an angle to the surface of said body and means for moving said body and magnet relatively to each other so that said magnetic conditions or impressions will be successively carried past the axial or polar line of the magnet, for the purpose set forth.

37. The combination of a body containing a trail of magnetic conditions or impressions representing electrical impulses or undulation, an electromagnet whose axis or polar line is presented at an angle to the surface of said body, an electric circuit including a receiving apparatus, and means for moving said body and magnet relatively to each other so that said magnetic conditions or impressions will be successively carried past the axial or polar line of the magnet, for the purpose set forth.

38. An apparatus for storing or recording electrical impulses, which consists of the combination of an electromagnet in a circuit over which such impulses flow, a body or surface capable of retaining magnetic impressions or conditions, means for moving the said body or surface and said electromagnet relatively to each other so as to present successive portions of said body or surface to the action of said electromagnet and means whereby the impulses flowing from said electromagnet will cause corresponding magnetic impressions or conditions to be made at successive points in said body or surface by magnetizing the same substantially transversely to the said line of movement.

39. An apparatus for storing or recording electrical impulses, which consists of the combination of means for creating by such electrical impulses corresponding magnetic impulses, a body or surface capable of retaining magnetic impressions or conditions, means for supporting the said body or surface within the field of said magnetic impulses and means for moving said body or surface and the seat of said magnetic impulses relatively to each other so as to cause successive portions of said body to cut the lines of force of said magnetic impulses.

40. A phonogram or sound-record consisting of a suitable body or base having impressed therein or thereupon magnetic conditions or influences corresponding to the sounds.

41. A phonogram or sound-record consisting of a suitable body or base of steel having impressed therein or thereupon magnetic conditions or influences corresponding to the sounds or to the air-waves accompanying the sounds.

42. A phonogram or sound-record consisting of a paramagnetic body or base in the form of a wire or strip, having impressed therein or thereupon magnetic conditions or influences corresponding to the sounds or to the air-waves accompanying the sounds.

43. A body or base of magnetic material containing permanent magnetic impressions of electric signal-currents.

In testimony whereof I have hereunto set my hand in the presence of two witnesses.

VALDEMAR POULSEN.

Witnesses:
E. S. HAZEMANN,
R. J. SCHMIDT.